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Time Dependent Valuation (TDV) Hourly Residential Modeling

***California Building Energy Efficiency Standards
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Time Dependent Valuation (TDV) – Hourly Residential Modeling (HVAC, DHW, attics, etc.)

Description

Time Dependent Valuation (TDV) depends on hourly estimates of building energy consumption in order to distinguish between measures that perform well on-peak and those that do not. The current residential analysis tools only calculate building heating and cooling loads on an hourly basis. HVAC equipment efficiency is applied to the annual summation of hourly loads, and so the current analysis tools do not know when the energy is used (or saved). Water heating energy consumption is also estimated on an annual, not hourly, basis. Likewise, the current standards provide credits for duct tightening and attic performance (radiant barriers and cool roofs), but only on an annual basis. In order to implement true TDV, it is necessary that the residential analysis be for all of these measures be done on an hour-by-hour basis.

The TDV project team has developed proposals for accomplishing this. See the separately submitted description of the proposed approach for modeling HVAC equipment performance. For domestic hot water heating (DHW), we have proposed an hourly hot water usage profile which may be applied to the currently standards' calculated annual hot water load, and we will be looking at methods for upgrading the estimates of hot water usage. For duct tightening and attic performance, we have developed a method for estimating hourly performance based on outdoor air temperature, solar gains and other parameters.

Benefits

This proposal will allow residential designers to more accurately estimate the time and magnitude of energy savings on an hourly basis. The result will be more demand responsive building designs. Building owners will see reduced energy and demand costs. As with other TDV supported measures, the long term benefits will extend to the state through reduced peak system demand and a reduced need to build additional power plants and transmission/distribution lines.

Environmental Impact

TDV will likely produce long term reductions in on-peak power plant emissions by reducing peak demands from residential building designs. This measure will also encourage building level peak demand reduction strategies such as glazing orientation, but only to the extent these technologies are viable in the marketplace. Other than these, we do not foresee any major changes in environmental factors resulting from adoption of TDV.

Type of Change

This way of characterizing residential building performance would affect both prescriptive and performance approaches (see related measure to implement hourly HVAC equipment models in the residential standards). The basic building design requirements would not be changed by this proposal, but the differences in measure performance would be recognized as optional measures throughout the standards.

The prescriptive approach would only be affected to the extent that different packages of measures are adopted based on TDV performance. The basic package would likely be unchanged. Other packages could be developed that require measures with better on-peak performance.

The performance approach trade-offs among building measures could acknowledge better or worse performing design approaches.

Adoption of this hourly performance approach would require substantial modifications to the ACM Manual and the compliance programs. The most substantial changes would be to the residential analysis methods, which would change from annual performance of measures to hourly performance (e.g. hour-by-hour HVAC equipment models and water heating usage). The Manuals would need some additional material to explain the concepts and consequences of TDV to designers and the compliance community. Exceptional methods would need to be updated to account for the hourly analysis methods of this proposal.

Measure Availability and Cost

Because it is not a single measure or piece of hardware, measure availability and cost does not apply directly to this hourly performance method. To the extent some models or types of measures become more highly valued under TDV than they currently are valued, these changes could affect their availability and cost in the market. Based on past experience, we would expect the cost of higher performance measures to come down over time as it becomes more widely available.

Useful Life, Persistence and Maintenance

Because it is not a single measure or piece of hardware, useful life, persistence and maintenance do not apply directly to this hourly performance proposal. Some of the mechanisms used by manufacturers to achieve better on-peak performance with their HVAC equipment or other measures may be more or less persistent or may require different kinds of maintenance, but this is difficult to assess, given the fluid nature of the residential building market.

Performance Verification

This measure may constrain builders to install measures with the correct performance characteristics (unless minimally compliant measures are assumed). Building officials will be called upon to verify that specified measures are actually installed. Beyond that, there should be no special performance verification required.

Cost Effectiveness

This approach to measure performance is not fundamentally a cost-effectiveness question. It simply allows the Standards to distinguish more accurately between differently performing measures which are already available on the market.

Analysis Tools

The existing residential compliance tools need to be upgraded to include hourly modeling capabilities. The TDV project team has developed such a tool in a prototype spreadsheet format. (See also the companion proposal for HVAC system performance.)

Relationship to Other Measures

This new approach to hourly performance modeling would affect interaction among measures at the whole building level; for example, high performance HVAC units might provide additional trade-off opportunities with other measures. These kinds of trade-offs, however, have been available for many years, differing only in degree with the trade-off opportunities provided by this proposal.

Bibliography and Other Research

The TDV methodology has been developed over the past several years by a consultant team funded and lead by PG&E, with support and active participation by the CEC staff, Southern California Edison, Southern California Gas Co., and other interested parties.

The results of this analysis has been published in a series of reports, all of which are posted on the TDV Project web site at: www.h-m-g.com/tdv/index.htm.

Key documents available at that location include:

Questions about the TDV methodology may be addressed to:

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